**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington, D.C. 20554**

In the Matter of

GN Docket No. 12-354

Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band

***Via Electronic Filing***

**COMMENTS OF WHITESPACE ALLIANCE**


Dr. Apurva N. Mody
Chairman, WhiteSpace Alliance™
1215 Pawtucket Blvd., Suite 42
Lowell, MA 01854
404-819-0314
apurva.mody@WhiteSpaceAlliance.org

Ivan Reede
Vice Chairman, WhiteSpace Alliance™
20 Medoc Kirkland
Qc, Canada, H9H 5B3
514-620-8522
ivan.reede@WhiteSpaceAlliance.org


**Via the ECFS**

## COMMENTS OF THE WHITESPACE ALLIANCE

1. WhiteSpace Alliance[1] (WSA) respectfully submits its Comments in the above-captioned Proceeding.
2. WSA (www.WhiteSpaceAlliance.org) is a global organization that promotes the development, deployment and use of products and services in the U.S. and globally that

[1] WhiteSpace Alliance (www.WhiteSpaceAlliance.org)

exploit white space technologies as a means of efficiently using underutilized spectrum to provide advanced broadband capabilities. WSA promotes the opportunistic use of spectrum by cognitive radios, that with geo-location databases (or together with sensing technologies and beaconing approaches), can operate on vacant, unused or unassigned frequencies (as is the case at present in the U.S. with television white spaces), as well as on frequencies that may be licensed but are not in use.

3. Recently, the WhiteSpace Alliance endorsed the United States Presidents Council of Advisors on Science and Technology (PCAST) report[2] promoting spectrum sharing and more efficient use of spectrum through new cognitive radio technologies and tranceiver standards[3]. WSA is developing technologies that allow spectrum sharing between various kinds of systems over many bands and in many different markets.

## INTRODUCTION

4. On December 12, 2012 the Commission issued a Notice of Proposed Rulemaking, under GT Docket 12-354, in which the Commission seeks comments related to spectrum sharing in the 3550-3650 MHz and the 3650-3700 MHz Band.
5. WSA endorses the President' s Council of Advisors on Science and Technology (PCAST) report promoting spectrum sharing and more efficient use of spectrum through new cognitive radio technologies, receiver standards and interference mitigation techniques.
6. WSA applauds the Commission for adopting the recommendations of the PCAST report for finding novel ways to use the spectrum for commercial uses.
7. WSA agrees with the FCC that the spectrum should not remain unused if there are radio technologies that can make use of the spectrum while preserving the established regulatory framework. Spectrum can be shared in frequency, time or even space.
8. The WSA supports the FCC' s Notice of Proposed Rule Making (NPRM), to create a new Citizens Broadband Service in the 3550-3650 MHz band (3.5 GHz Band) currently utilized for military and satellite operations, which will promote major advances that enable more efficient use of radio spectrum.
9. We agree with the commission as stated in Paragraph 3 that increased use of small cell network deployments can multiply wireless capacity within existing spectrum resources. We also agree that increased spectrum sharing can make large swaths spectrum newly available

[2] http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf
[3] http://www.dailymarkets.com/stock/2013/01/28/whitespace-alliance-endorses-pcast-report-on-spectrum-sharing/

for broadband use.

10. WSA believes that technologies can be developed that can support not only small cell deployments in these bands but even macro-cell deployments.
11. WSA has already created standards and interoperability specifications which support spectrum sharing under the Commission's Part 15 rules for operation in a wide variety of bands including the TV broadcast bands. These standards support applications which include broadband wireless access in rural, remote and other areas, wireless local area network operations, including home, business and cellular data offload applications, and machine to machine ("M2M") operations, including smart grid and smart metering applications.
12. WSA endorses the FCC' s viewpoints as proposed in GT-12-354, Paragraph 6 (hereinafter "Paragraph" followed by the paragraph number), supporting fixed and unlicensed or lightly licensed operation in these newly available bands. WSA also supports opportunistic use of licensed spectrum that is not being used by the current license holders.
13. WSA supports the establishment of a regulatory framework as suggested in Paragraph 7 permitting the opportunistic use of cognitive, location based, multi-beam antenna devices in these Bands.
14. WSA agrees with the FCC that opening up the 3550-3700 MHz spectrum to these types of radio sharing technologies will spur innovation to address meaningful communications needs of consumers, businesses and governments while also protecting incumbent mission critical needs such as DoD radars.

## WSA SUPPORTS SPECTRUM SHARING IN TIME, FREQUENCY AND SPACE TO IMPROVE SPECTRUM UTILIZATION

15. WSA agrees with the FCC that the previous approach of allocating spectrum for localized and application specific solutions results in poor spectrum utilization and efficiency. It also results in depriving the public of a revenue stream that they could have benefited from through commercial deployments.
16. WSA will be supporting a wide variety of standards to allow the use of any part of the spectrum.
17. WSA believes that technologies can be created that can amply demonstrate co-existence between different systems with disparate technologies and even licensed systems with

unlicensed users.

18. WSA believes that spectrum can be shared by different systems by accessing it at different times even though they may be in the same geographical area. Spectrum may also be shared through spatial or geographical separation (e. g. using multiple antenna and beam-forming technologies). Spectrum may also be shared in code-space by using different orthogonal codes for different systems (e. g. CDMA systems).
19. In Paragraph 41 of the NPRM, the commission has asked if the rules developed for the TV White Spaces (TVWS) are applicable to these bands as well. WSA has created Standards for White Space Device (WSD) deployments in the TV Bands that can access the database service and based on parameters defined there, can change their radio parameters to utilize the spectrum at a given location and at a given time. WSA believes that such technologies can be readily applied to the 3550-3700 MHz and other bands.
20. WSA believes that technologies exist to enable real time and semi real time spectrum sharing, where such sharing can be enabled through higher layers such as the database (also referred to as the SAS in the NPRM), through some network layer co-existence techniques, spectrum sensing or even via real time access of specially designed beacons signals.

## WSA BELIEVES THAT SPECTRUM SENSING MECHANISMS MAY BE SELECTIVELY USED FOR SPECTRUM SHARING IN THESE BANDS

21. FCC in Paragraph 125 has asked if spectrum sensing techniques may be deployed for spectrum sharing and interference mitigation in these bands.
22. Some of the Standards supported by the WSA, such as IEEE 802.22-2011 (Wi-FAR™)[4] Standard supports a variety of spectrum sensing techniques such as cyclostationary approaches, higher order statistics, covariance based approaches, matched filter, energy detection etc. to detect and recognize the signals of interest. The IEEE Standard 802.22-2011™ has created a dedicated Annex that describes these techniques and provides detailed quantitative performance comparisons for various techniques using over-the-air TV Broadcast captured signals that were provided to the various participants.
23. In general we believe that multiple sensing techniques are needed to accurately detect and characterize the signals *with reasonable computational complexity* and for all types of signals.

[4] www.ieee802.org/22 - IEEE 802.22 Working Group on Wireless Regional Area Networks

24. IEEE 802.22 Working Group investigated techniques that would allow detection of signals some 20 dB below the noise floor. For this case, the use of a combination of techniques, such as energy (interference) detection, Receiver Signal Strength Indication ("RSSI") monitoring, and more complex feature based techniques, were needed to detect and identify the signal.
25. Spectrum sensing of incumbents is challenging in environments with large signal dynamic range. However when a signal is specifically designed to be detected (e. g. beacon), spectrum sensing becomes more feasible and realizable.
26. Spectrum sensing may be used by the incumbents, priority users or by general authorized users to adapt their transmission parameters.
27. We continue to believe that spectrum sensing will play an important role in Dynamic Spectrum Access and Spectrum Sharing.

## WSA SUPPORTS THE USE OF NOVEL INTERFERENCE MITIGATION TECHNIQUES SUCH AS SIGNAL BEACONS TO ENABLE SPECTRUM SHARING

28. In Paragraph 149 and 152, FCC has asked if a beaconing technology can be applied for interference mitigation in these bands.
29. IEEE recently authorized a revision project to add ***Advanced Beaconing*** capabilities to the IEEE Standard 802.22.1™-2010 to enable spectrum sharing in the 3550-3650 MHz band with existing radars and fixed satellite earth stations. This revision PAR was introduced to support spectrum sharing and more efficient use of spectrum through new cognitive radio technologies and interference mitigation techniques.
30. According to the current plan, FCC proposes to use database service or a Spectrum Access System (SAS) driven operation which will enforce large exclusion zones along the US coastline to protect U.S. Navy coastal operations and other Department of Defense test and training areas. Such large exclusion zones will not allow majority of the large cities along the US coast to gain benefits from this spectrum.
31. However, advanced beaconing approaches, such as the one developed in the IEEE Standard 802.22.1-2010 originally designed for interference protection of licensed wireless microphones may be used for these bands. Such an advanced beacon will enable spectrum sharing and make 100 MHz of spectrum available nation-wide, and especially in the coastal areas where significant US population resides. Such a beaconing approach allows spectrum

sharing operation in semi-real time and dynamically, which otherwise could not be supported through any other means easily.

32. The designed beacon could be transmitted by the incumbent users and may contain peace time temporal patterns of the radars and satellite earth stations that require protection which when combined with some universal time clock can help commercial communications systems to use the empty time slots for their operation. During emergency mission critical scenarios, the beacon will be able to send urgent messages, to ask all the commercial systems in a particular local or regional area to shut down immediately. Hence, except for these beacon protection zones where mission critical operation is required by DoD, all the other areas (east and west coast map in NRPM) will still be able to use this spectrum. Enhanced security features, spectrum management, self organizing network and relay capabilities will also be included in the beacon specification.
33. For systems that do not have universal time clock functionality, and that cannot operate on a real time basis, the beacon will simply act as an information source for a dedicated receiver on the shore that may be connected to the SAS database service, which can then provide more dynamic updates to all the commercial communications systems to change their parameters of operation.
34. Hence, signal beacons will add a new capability for real time dynamic and locally / regionally optimized spectrum sharing which will enhance the spectrum efficiencies and allow the FCC to reach its goal. Also, such an approach that will allow nation-wide deployment of services in these bands including the US coastal areas will result in added revenues.

## WSA SUPPORTS THE USE OF VARIETY OF INTERFERENCE MITIGATION TECHNIQUES THAT CAN BE DEPLOYED COOPERATIVELY TO ENHANCE THE SPECTRUM EFFICIENCY

35. As stated in Paragraph 153, WSA agrees that some of the mitigation techniques described above may be employed cooperatively with other mitigation techniques resulting in greater compatibility than could be achieved by either technique individually.
36. Database driven SAS can play an important role in interference mitigation techniques and especially for fixed satellite stations (FSS) that are required to be protected in 3550-3700 MHz.

37. WSA believes that 'PUSH' capability should be required in the SAS to ensure that at the time of emergency, all the priority and general authorized access systems can be shut down immediately. Such a PUSH capability has been already accepted by the OfCom (United Kingdom) for the proposed rules for the WhiteSpace Device operation in TV Bands.[5]
38. WSA also believes that the rules that allow TV Band WhiteSpace devices to operate even when they have lost connectivity with a database for as long as 24 hours need to be revised for these bands. The SAS database connectivity should be checked more often for systems that are interested in sharing these 3550-3650 MHz bands with the incumbents.
39. Further the FSS antenna is a highly directional and protection can be tailored to optimize the antenna dishes directivity which is most likely aimed at geo-stationary satellites.
40. Interference to FSS can be addressed in 3 parts being 1) in-band signal disruption, 2) intermodulation interference from larger out-of-band signals, 3) receiver saturation. Understanding these characteristics along with antenna dish directivity interference protection can be tailored for optimum spectrum effeciencies.
41. Interference from radars to communication systems in the band can be controlled by the IEEE Standard 802.22.1 Advanced Beacon providing notice to PHY layers that protection is necessary. In the same vein, radars will be afforded protection from communication devices when beacon signals are detected.
42. In conclusion section 157 the WhiteSpace Alliance is very much interested in working with FCC, NTIA and DoD on furthering the concept of creating an advanced beacon architecture for sharing spectrum between federal, DoD and non federal users, creating a paradigm shift in the way spectrum is shared.

## WSA RECOMMENDS A RIGOROUS ANALYSIS OF SEPARATIONS AROUND FIXED SATELLITE SERVICE (FSS) EARTH STATIONS

43. The protection of the FSS below 3700 MHz is an issue requiring more rigorous analysis. Exclusion zones can be augmented by new technologies like the geo-location database.
44. Industry experience in the 3650-3700 MHz band indicates that if FSS protection was by power control and OOBE, rather than by spatial separation, the number of wireless deployments would be significantly larger than it is today.

[5]UK OfCom Consultation on WhiteSpace Device Requirements in TV Bands - http://stakeholders.ofcom.org.uk/consultations/whitespaces/?utm_source=updates&utm_medium=email&utm_campaign=whitespaces

45. We propose that the Commission take into account the possibility of actions by the 3700-4200 MHz band FSS license holders to improve the immunity of their sites from interference. This could even be done by building a fence of moderately good conducting material around the FSS site. Such one-time investments can create immunity from interference for FSS earth stations. This would protect FSS operations as well as pay for itself many times over if access to (and use of) adjacent spectrum was created.

## WE AGREES THAT SPECTRUM SHOULD NOT REMAIN UNUSED IF THERE ARE RADIO TECHNOLOGIES THAT CAN MAKE OPPORTUNISTIC USE OF THE SPECTRUM

46. WSA supports FCC' s goal to enable more efficient use of spectrum in numerous innovative ways as suggested above.
47. WSA has already created standards and interoperability specifications which support spectrum sharing for operation in the TV broadcast bands. WSA continues to create spectrum sharing interoperability standards and technologies that apply to other bands for a wide variety of applications such as rural, remote and other areas, wireless local area network operations, including home, business and cellular data offload applications, and machine to machine ("M2M") operations, including smart grid and smart metering applications.

## CONCLUSION

48. WSA endorses the President' s Council of Advisors on Science and Technology (PCAST) report promoting spectrum sharing and more efficient use of spectrum through new cognitive radio technologies and interference mitigation techniques.
49. WSA applauds the Commission for adopting the recommendations of the PCAST report to find novel ways to use the spectrum for commercial uses.
50. WSA has and continues to develop technologies that will support the regulatory framework to be established in the 3550-3650 MHz bands.

Respectfully submitted,

Respectfully submitted,
**WHITESPACE ALLIANCE**

/s/
Dr. Apurva N. Mody
Chairman, WhiteSpace Alliance
1215 Pawtucket Blvd., Suite 42
Lowell, MA 01854
404-819-0314
apurva.mody@WhiteSpaceAlliance.org

/s/
Ivan Reede
Vice Chairman, WhiteSpace Alliance
20 Medoc Kirkland
Qc, Canada, H9H 5B3
514-620-8522
ivan.reede@WhiteSpaceAlliance.org

Dated: February 17th, 2013